THE INDUCIBLE FORM OF HSP70 IN PORCINE SMALL INTESTINE, COLON AND SERUM

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Background & Objectives

Modern swine production includes practicalities that may be stressful to pigs. At cellular level, stress response includes synthesis of special stress proteins, heat shock proteins (HSP), which have several roles in helping to maintain the protein homeostasis. HSPs form a protein family, classified according to their molecular weights. One of the best-known is the 70 kDa family (HSP70), which contains both inducible (HSP72) and constitutive (HSP73) forms. Many environmental and pathological factors are known to activate HSP72 expression, also including psychological stress (Fukudo et al. 1997). Altough HSPs are intracellular proteins, small amounts of HSP72 can be found in serum, also in unstressed individuals (Pockley et al. 1998), but the source of serum HSP is still unclear. Among the organs that respond to stress, intestines belong to those that are most stress-sensitive (Söderholm & Perdue 2001). The main question asked in this study was whether HSP72 in the intestines varies with growth rate, and whether serum HSP72 correlates with known indicators of stress.

Material & Methods

40 experimental pigs (EP) used in this study were raised individually in 1.0 x 2.5 m pens and slaughtered two together at an experimental slaughterhouse. Additional samples were taken from 10 ordinary slaughterhouse pigs (SP). Five of the SP were physically injured (muscle and tail) and five showed no signs of injury. The animals were slaughtered in a commercial slaughterhouse and stunned with CO_2. The samples from small intestine, colon and blood were taken in the connection of slaughter. The inducible HSP70 was analysed immunologically, blood lactate concentration with a lactate analyser and serum cortisol by radioimmunoassay. Differences in the amounts between the two groups were calculated by paired t-test using GraphPad Prism software (GraphPad Software, USA). Differences were regarded as significant at $P=0.05$. Linear regression analysis was used to calculate the coefficients of correlation.

Result & Discussion

The carcass weight of the 40 EP was 81.0 ± 7.5 kg and that of SP significantly ($P<0.05$) lower, 74.7 ± 10.9 kg. HSP72 was detected in the small intestine, colon and serum. Amounts of HSP from all tissues studied were significantly higher in SP than EP ($P<0.001$), but also among SP the injured pigs had higher colon HSP72 than the apparently healthy pigs ($P<0.05$). There were positive correlations between the amounts of HSP72 in colon and small intestine ($r=0.54$; $P<0.001$; $n=50$), colon and serum ($r=0.66$; $P<0.001$; $n=50$), and small intestine and serum ($r=0.41$; $P<0.01$; $n=50$). A negative correlation was found between carcass weight and HSP72 content in colon ($r=-0.54$; $P<0.001$; $n=50$) or serum ($r=-0.45$; $P<0.01$; $n=50$). HSP72 in colon correlated with carcass weight also in both groups separately (SP, $r=-0.70$, $P<0.05$, $n=10$; EP, $r=-0.35$, $P<0.05$, $n=40$). Lactate and cortisol concentrations did not correlate with HSP72 in any tissue.

The negative correlation between HSP72 in colon and carcass weight suggests that pigs with high concentration of HSP72 were stressed and did not grow as well as less stressed animals with lower HSP72 concentration. This speculation is supported by a finding, which shows that chronic stress reduces the growth of the animal (Santos et al. 2000). We detected HSP72 also in serum and there was a positive correlation between HSP72 in serum and colon. A closer analysis of the data shows that the levels of serum HSP72 start to rise when colon HSP72 reaches approximately 3.9 μg/g tissue. If serum HSP72 comes from the colon, this may represent the point when colonal epithelium starts to loose its integrity.

Conclusions

The correlation between HSP72 in serum and colon suggests that at least part of the serum HSP72 comes from the colon, but a larger number of pigs is needed to show whether serum HSP72 is a useful stress indicator.

References

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